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The nature of natural: defining natural character for the New Zealand context

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Abstract: New Zealand has a long-standing statutory policy goal to preserve the natural character of the coastal environment and various freshwater environments and their margins. In the absence of an authoritative definition, it has not been possible to develop a method to measure natural character and its change, nor the outcomes of the long-standing national policy goal. Here we develop a definition of natural character that is relevant and useful in the New Zealand environmental, cultural and legal/policy context. Literature-derived interpretations of natural character and equivalent concepts are evaluated as to their potential suitability for developing a biophysical definition of natural character. Using a set of carefully designed criteria a subset of interpretations are condensed into a definition of natural character. The application of this definition is qualified following consideration of the literature addressing human perception and experiences of natural character. Appropriate reference conditions and baselines for evaluating natural character in different contexts are discussed.

Keywords: baselines; coastal environment; environmental naturalness; environmental policy; human perception; reference conditions; Resource Management Act

Introduction

Natural character is a complex concept. This concept, and the equivalent term [environmental] naturalness, is used by a variety of disciplines including conservation biology/ecology, landscape planning and design, environmental management and restoration, resource planning, geography, ethics/philosophy and psychology.

New Zealand has a long-standing statutory policy goal to preserve the natural character of the coastal environment and various freshwater environments and their margins. Although this policy has been incorporated into several statutes, the term 'natural character' is not defined. In the absence of an authoritative definition it has not been possible to develop a comprehensive methodology to measure natural character and its change, nor the outcomes of the long-standing national policy goal.

The purpose of this paper is to develop a 'first principles' definition of natural character that is relevant and useful in the New Zealand environmental and legal/policy context. Such a definition should be comprehensive, useful for decision-makers, and provide a basis for evaluating the outcomes of the national policy goal.

Methodology

The first stage in developing a 'first principles' definition was the analysis of the New Zealand legislative, policy and environmental contexts. The insights gained from this were used to develop a comprehensive set of criteria against which to evaluate interpretations of other authors.

A variety of sources (including online databases) were searched to find papers and books that addressed natural character and equivalent concepts. The need to conduct a search on equivalent concepts was because the term 'natural character' is not widely used in the published literature outside the New Zealand context. Searches on terms such as 'natural' and 'naturalness' were qualified to address the usages of these terms in the context of disciplines such as environmental management, biological conservation and geography.

Although the New Zealand policy applies to a limited range of ecosystems, no such limitations were placed on the literature analysis. Most of the publications reviewed either addressed natural character and equivalent concepts without reference to particular ecosystems or focused on terrestrial ecosystems. Relatively few papers addressed the concept of natural character or environmental naturalness for marine ecosystems.

Disciplines represented in relevant publications included conservation biology/ecology, landscape planning and design, environmental management and restoration, resource planning, forestry, geography, ethics, philosophy and psychology. Some publications focus on human perceptions of natural character or environmental naturalness and typically do not define natural character.

A suite of interpretations derived from the literature analysis were assessed against a set of carefully developed criteria. As our purpose was to develop the most appropriate definition for the New Zealand context, we sought a relatively broad definition. This was achieved by combining interpretations as appropriate while excluding those that did not meet the criteria.

Towards developing a definition of natural character

The purpose

Definitions or interpretations of natural character, environmental naturalness, or equivalent concepts are usually developed for a specific purpose. These purposes have included:

- Evaluating the utility of naturalness as a biological conservation objective (e.g. Angermeier 2000; Siipi 2004)
- Using naturalness as one of a suite of criteria for biological conservation (e.g. Margules 1986)
- Evaluating whether it is a useful concept for distinguishing/selecting between environmental/ecological management strategies (e.g. Siipi 2004)
- Contributing to a framework for assessing visual quality and ultimately measuring the effect of landscape change on visual character (e.g. Tveit et al. 2006)
- Providing guidance for inventories and Resource Management Act 1991 decision making (e.g. McRae et al. 2004)

The purpose of the definition being developed in this paper is to contribute to the analysis of policy implementation, including the measurement of natural character and its change.

New Zealand legislative and policy context

New Zealand's long-standing statutory policy goal to preserve the natural character of the coastal environment, riparian and various freshwater environments is in the planning/development control and protected areas legislation. This policy was developed in the early 1970s as part of the response by the then government to widespread public concern about the rapid rate of coastal and lake-margin development (Minister of Works and Development 1974). It was first included in the planning/development control legislation via a 1973 amendment to the Town and Country Planning Act 1953. This amendment added a new 'matters of national importance' section, which included the preservation of the natural character of the coastal environment and the margins of lakes and rivers.

This matter of national importance was transferred into the Town and Country Planning Act 1977 and subsequently expanded in the Resource Management Act 1991 to include wetlands, and the bodies of rivers and lakes. While the terrestrial inland boundary of the coastal environment is not defined in the Resource Management Act, the outer boundary is the 12-nautical-mile limit of the territorial sea.

The policy goal to preserve the natural character of the coastal environment and the margins of lakes and rivers was introduced into the protected areas legislation as part of one of the three purposes of the new Reserves Act 1977. This purpose remains unchanged. Initially, implementation of the natural character policy via the planning and protected area legislation was strongly linked by a series of mechanisms, including:

- An interagency committee
- Potential-coastal-reserves surveys of coastal counties and boroughs
- Formal communication of survey results to councils for them to address in their planning documents
- Allocation of government funding for the Crown to purchase coastal reserves

The public concerns that had initially led to government action on natural character largely focused on aesthetic appreciation and recreational experiences of natural character (Maplesden & Boffa Miskell 2000), but over time the public has become increasingly concerned about the conservation of nature. This has been reflected in the expanded scope of judicial interpretations of natural character adopted in decisions made under the Resource Management Act.

Several other Western countries have also incorporated the protection of environmental naturalness into their legislation. Federal legislation in the USA (e.g. Wilderness Act 1964) provides the context for much of the discussion about naturalness within biological conservation and ecological literature (e.g. Landres et al. 1998; Czech 2004).

Cultures vary in their understanding and recognition of environmental naturalness. Economically developed nations that have been colonised relatively recently by Western culture tend to have shown the strongest desire to protect environmental naturalness (Dunlap 1999). The loss of indigenous species and ecosystems proceeded extremely rapidly in these nations after colonisation and that may have been an important trigger.

Probably the most extreme example was New Zealand, which during the second half of the 19th century experienced one of the most rapid periods of indigenous forest clearance anywhere in the world (Tong & Cox 2000). At its peak in the decade between 1890 and 1900 forest clearance removed 27% (3.5 million ha) of New Zealand's forest. There are eloquent accounts (e.g. Froude 1886) of the extensive clearing and burning of magnificent lowland forest during this time so that the settlers could plant introduced pasture grasses for grazing by introduced livestock.

New Zealand environmental context

New Zealand is unique as an isolated, long, narrow, mountainous archipelago extending between 29 and 52 degrees latitude in the South Pacific Ocean. It lies within the tectonically active 'Pacific Ring-of-Fire' and intercepts the Southern Hemisphere westerly wind zone. Accordingly, parts of New Zealand have frequent and sometimes severe natural disturbance compared with that in stable continental environments.

New Zealand has only been settled by humans for the last 730 years (Wilmshurst et al. 2008). Settlement was initially by people of Polynesian origin, and from the 1800s predominantly by those of European/Caucasian ethnicity (King 2003).

The many millions of years of isolation from other land masses resulted in a unique and vulnerable biota. After the extinction of dinosaurs New Zealand did not follow the rest of the world into the 'Age of Mammals' but instead entered the 'Age of Birds' (Taylor & Smith 1997). Many bird species evolved unique life forms, often losing the power of flight and feeding on the ground in the absence of terrestrial predators. The only terrestrial mammals at the time of human settlement were three species of bat (one now extinct), two of which also evolved to feed extensively on the ground (Wilson 2003). These ground-based habits of many indigenous bird species made them highly vulnerable to human hunting, and subsequently to introduced mammalian predators.

Before human arrival there was a very high level of endemism in both plant and animal species, with 70% of land and freshwater birds and 85% of flowering plant species being endemic. Since human settlement there have been many species extinctions, particularly of endemic species of fauna including all species of the ratite moa. About 46% of New Zealand bird species present before human arrival have become extinct (Taylor & Smith 1997). Today New Zealand's level of threatened species is rated among the highest in the world (Hitchmough et al. 2007; Ministry for the Environment 2007). Introduced species have had a major impact on the remaining indigenous terrestrial and freshwater biota and ecosystems.

Before human arrival, about 78% of New Zealand was forested. Today, indigenous forest cover is 23%, with much of that remaining being in steep mountainous country. Farmland now makes up 52% of the country, which is much higher than the world average of 37% (Tong & Cox 2000). Nationally, 10% of wetlands present before the arrival of humans remain. In the North Island this is reduced to 4.9% (Ministry for the Environment 2008).

The natural character of many fresh and estuarine waters has been lost or degraded by drainage, construction of flood control channels and stopbanks, removal of riparian vegetation, point and non-point discharges.

Approximately one-third of New Zealand lakes have poor water quality, with 13% of monitored lakes being extremely degraded and commonly subject to algal blooms (Ministry for the Environment 2007, 2008). Nutrient (nitrogen and phosphorus) levels in lakes with pastoral catchments are 2–6 times higher than in lakes with naturally vegetated catchments. Water clarity of lakes in pastoral catchments is one-fifth that of lakes in natural catchments (Ministry for the Environment 2007).

While New Zealand marine environments are relatively healthy by international standards, approximately 30% are disturbed by human activities (Ministry for the Environment 2007). Large-scale commercial fishing removes large numbers of organisms, destroys marine habitats, and disrupts marine food chains (Ministry for the Environment 2007). Ships have introduced new species that have had, or are likely to have, an adverse impact on marine ecosystems.

Considerable areas of sheltered coastal margins have been modified by human activities such as land drainage, causeway construction, seawalls, reclamation and other development. Many nearshore marine environments have been affected by excessive nutrients and increased levels of sediment derived from human land use.

In spite of all this environmental damage, relatively intact areas remain, albeit many in more mountainous areas and without much of their original fauna. Few intact areas remain in lowland and coastal

Table 1. Criteria for evaluating possible interpretations of naturalness

Criteria	Rationale for choice of each criterion
1. Applies across the full spectrum of environments from pristine wilderness to the highly modified	The New Zealand national policy to protect natural character applies to the coastal environment, wetlands, lakes and rivers and their margins. These exist across a broad spectrum of environmental conditions ranging from relatively pristine at one end to highly modified (by industrialisation and other development) at the other. In the New Zealand context a definition of natural character needs to cover the full spectrum of environmental conditions.
2. Addresses the effects of human structures and activities	Much of the original impetus in the early 1970s for the development of policy to preserve the natural character of the coastal environment and margins of lakes and rivers was a response to coastal and lake-margin development, including structures. A definition of natural character for New Zealand should address the effects of human structures and activities.
3. Can address ecological naturalness in the New Zealand context	New Zealand's long history of isolation from other land masses led to the evolution of a unique biota and many unique ecosystems. As the last major land mass to be settled by humans, New Zealand saw many of the dramatic changes (species and ecosystem loss, ecosystem degradation) occurring over a relatively short timespan. In addition its terrestrial and freshwater biota and ecosystems have been highly vulnerable to the impacts of introduced species. A definition of natural character for New Zealand would acknowledge that native species are more natural than introduced species. It would also acknowledge that the more natural ecosystems are those that more closely resemble what would have occurred if humans and their agents (introduced species) had not arrived.
4. Can apply to terrestrial, freshwater and marine environments	The New Zealand legislation on natural character applies to terrestrial, freshwater and marine environments, although not all ecosystems within these environments are covered by the policy. In marine environments, the national policy applies from mean high water springs to the 12-nautical-mile territorial sea boundary. In terrestrial environments, it applies to the undefined terrestrial 'coastal environment' and the 'margins' of lakes and rivers.
5. Can be used in a meaningful way to measure progress in ecological restoration	Extensive areas of lowland and coastal terrestrial and freshwater ecosystems in New Zealand have been destroyed, and much of what remains has been seriously degraded. Ecological restoration is encouraged by the New Zealand Coastal Policy Statement (Minister of Conservation 1994). The outcomes of active restoration programmes should be considered positively in a natural character definition for the New Zealand context.
6. Provides for the use of reference markers to give context	Natural character is not an absolute concept. As such it is helpful to use reference conditions against which change can be measured. A definition of natural character in the New Zealand context would provide for the use of reference conditions and baselines as appropriate.

environments, except for some offshore islands and the most remote parts of mainland New Zealand.

Criteria for assessing literature-derived interpretations of natural character

From our analysis of the New Zealand context we developed a set of criteria for assessing literature-derived interpretations of natural character (Table 1). Each interpretation of naturalness derived from the literature review was then assessed against each criterion to qualitatively assess the extent to which the criterion was met.

Interpretations of natural character

This section describes nine interpretations of natural character/environmental naturalness that have been derived from the literature. These interpretations are largely based on biophysical attributes. In most cases an author used or advocated a single interpretation, although several authors (Siipi 2004; Ridder 2007a) compared interpretations.

Each interpretation is discussed individually and assessed against the six criteria in Table 1. This is followed by a synthesis that draws out the key elements to include in a proposed definition of natural character.

Interpretation 1: Naturalness as that which is part of nature

This interpretation excludes human culture's activities and constructions. It has been most extensively discussed in Western cultures, especially those populated by the English Diaspora (Dunlap 1999).

While some ecology authors argue that because humans have evolved naturally, humans and all human activities are natural (Comer 1997; Haila 1997), others argue that if humans and all their activities are natural then the concept of 'naturalness' has no meaning (e.g. Hunter 1996; Siipi 2004). Anderson (1991) and Angermeier (2000) both argued that human activities are unnatural because of the use of technology. Angermeier (2000) observed that human culture and technology have transformed nature and overcome humanity's genetic limitations, resulting in technology-driven changes to the environment that are often more rapid and extensive than natural ecological changes.

Holmes (1995) distinguished between spontaneous nature and deliberated or intended culture. He criticised those that describe humans and their actions as part of nature for not recognising that humans have significantly evolved out from nature and its processes. Holmes observed that while human historical origins were natural, humans now could no longer be considered so.

Klein (2000) observed that in Western environmental ethics human beings are separated from nature and that humankind has a central position within the natural world. This central position makes humans either indifferent to nature (negative anthropocentric) or responsible for nature (positive anthropocentric).

Maplesden and Boffa Miskell (2000), in their analysis of the development of the concept of natural character in New Zealand law and policy, concluded that the primary components that underpin

natural character are natural processes, natural elements, and natural patterns. Various New Zealand court decisions support her analysis. For example the Environment Court in *Harrison v Tasman District Council* (1994) states: 'the word *natural* is a word indicating a product of nature…as opposed to man-made structures, roads, machinery etc.'

McRae et al. (2004) defined natural character as derived only from physical and biological elements, patterns, and/or processes of nature indigenous to the environment being considered. The level of natural character within an area has also been defined as being dependent on both the extent to which natural elements, patterns and processes occur and the nature and extent of modifications to ecosystems and landscapes (Boffa Miskell 2002).

Interpretation 1 addresses criteria 1, 3, and 4 in Table 1, but it is not sufficiently comprehensive to address adequately criteria 2, 5 and 6.

Interpretation 2: Naturalness includes humans and their activities

Many traditional indigenous cultures do not recognise a clear distinction between humans and nature. The 'world view' of New Zealand Māori is that everything in the universe (both inanimate and animate) has its own genealogy and that all are ultimately linked via the gods to Rangi (the male principle or 'sky-father') and Papa (the female principle or 'earth-mother') (Roberts et al. 1995). Humans have a central position within the natural world but have to respect the life-force of all natural things and beings (Klein 2000). In traditional Māori society complex rules were used to manage the relationships between components of the environment, and compliance was enforced primarily by fear of divine retribution or confiscation of resources by humans. Roberts et al. (1995) describe the Māori environmental ethic as one of conservation for human use where rāhui (restrictions that set aside an area and prohibit the harvesting of resources) are used to ensure resource sustainability for this use and not for the intrinsic values of the resources concerned.

This 'world view' did not prevent major losses of nature. For example, the arrival of the first humans and the Polynesian dog and rat in south-east New Zealand was followed by extinctions of many bird species and three species of frog and several lizards (Hamel et al. 2003). Throughout New Zealand 34 species (including all species of moa megafauna) out of a total of 93 endemic land bird species became extinct before the arrival of Europeans (Taylor & Smith 1997). There was widespread loss of eastern South Island forest and scrub vegetation (McGlone et al. 2003) and heavy exploitation of fisheries such as Northland snapper and various shellfish beds (Flannery 1994).

There are some Western belief systems or paradigms that do not appear to separate humans from nature. One example is the Gaia hypothesis (Lovelock 1988, 2000), which proposes a 'live earth' where the climate and chemical composition of Earth's atmosphere are kept in homeostasis until an internal contradiction or external force leads to a sudden jump to a new stable state. In this hypothesis humans are just another species, albeit one that can destroy the balance and may be destroyed by the resulting changes. Lovelock (2000) does however observe that humankind is remarkable because it has created itself as an 'entirely new entity' using a combination of attributes (including brain size, faculty of speech, use of tools, and socialisation).

Another Western paradigm is that of 'new ecology', which includes humans as part of complex and changeable biophysical systems. Under this paradigm there is no benchmark of stability derived from the non-human or natural world, human alterations of apparently stable ecosystems are not necessarily bad, and 'conservation' should proceed by way of little or no interference (Castree 2005). 'New ecology' is not an appropriate paradigm for New Zealand environmental management as it would lead to the loss of much indigenous biota and the loss and/or degradation of many ecosystems dominated by indigenous species.

Interpretation 2 does not address criteria 3, 5 and 6 from Table 1 and it is unclear how it would support criteria 1 and 2. Including this second interpretation in a definition of natural character would result in an ambiguous definition. With such a definition it would not be possible to measure progress towards implementing the natural character policy goal that is in New Zealand legislation.

Interpretation 3: Naturalness as a contrast to 'artifactuality'

In this interpretation naturalness is contrasted with artefacts. Siipi (2004) defined an 'artefact' as something that is intentionally brought into existence by humans to have specific properties that have some designed functions. Having a designed function implies that the entity ('artefact') can be used for fulfilling human desires or purposes. This incorporates the wide array of human constructions including walls, buildings, roads and rail lines, transmission networks, vessels and vehicles. 'Naturalness as a contrast to 'artifactuality' is an interpretation that is implied by a number of authors (e.g. Richmond & Froude 1998; Boffa Miskell 2002).

Siipi applied her definition of an 'artefact' to biotic elements. Some biotic elements (e.g. gardens and modern commercial fields) were defined as biological 'artefacts' because they had been brought into existence through species modifications and they had designed functions such as food production.

Interpretation 3 may be implicitly included in some human societal perceptions of naturalness. In a study of public perception of certain land uses in the Coromandel Peninsula, New Zealand, Fairweather and Swaffield (1999) found that a large sector of their sample group considered naturalness was most strongly diminished by the presence of constructions representing human settlement. The other large sector considered that naturalness was most strongly diminished by the presence of a particular type of 'biological artefact' – plantations of introduced pine trees. This second group did not react as strongly to the other common 'biological artefact' present on the Peninsula – pastoral farming using other introduced species.

Interpretation 3 addresses criteria 1, 2 and 4 in Table 1. It does not adequately address criteria 3, 5 or 6. This is because it does not address the attributes of areas that are not 'artefacts' and it does not provide a way to measure progress in ecological restoration.

Interpretation 4: Naturalness as historical independence from human actions

In this interpretation (which is one of Siipi's (2004) two preferred 'definitions' of naturalness) the most natural areas are those where there has been little or no human activity. These most natural areas would closely resemble the biological composition and structure of prehuman reference conditions.

The degree of independence from historical human actions can be difficult to measure unless either the detailed human history of an area is known or it can be determined from the current state. Landres et al. (1999) questioned the practicality of distinguishing between certain historical human-induced versus natural disturbances, particularly in areas where humans have been settled for a long time. They observed that for parts of the USA it is difficult to distinguish between the outcomes of historical forest fires caused by humans and those resulting from lightning strikes.

Since New Zealand was settled relatively recently, it is generally more practical to identify the prehuman state of New Zealand terrestrial environments and the subsequent changes than for other land masses. The same is theoretically true for the marine environment. Even so, basing naturalness assessments on historical independence from human actions is likely to be difficult to implement.

Interpretation 4 addresses criteria 1, 4 and 6 in Table 1. It does not address criterion 5 because this interpretation implies that past human restoration activities intended to repair damage from earlier human activities has made the affected areas less natural. Interpretation 4 only partly addresses criterion 3 because it implies that human actions to remove or control introduced plant and animal pests, and especially the past intensive management that has resulted in pest-free areas (e.g. Kapiti Island), has made such areas less natural. This interpretation only partly addresses criterion 2 because it focuses on historical independence from human actions.

Interpretation 5: Naturalness is where ecosystem processes occur without human intervention

This interpretation focuses on the lack of present and future human intervention without particular regard to what has happened in the past. In so doing it focuses on processes rather than outcomes. There are several variations on this theme.

The first is Ridder's (2007a) preferred definition of 'naturalness'. He considered naturalness to be where processes are in harmony with nature and there is a lack of human intervention. Ridder did not specifically address the outcomes of these processes. The primary focus was the concept of leaving nature alone. In a similar vein, Olwig (1984) questioned the naturalness of the intensive management needed to maintain the Jutland heaths in Denmark once they were no longer being farmed.

The second variation is the definition of naturalness by Schnitzler et al. (2008). They defined naturalness to be spontaneous natural ecosystem processes without human input and where no specific outcomes are sought and no species or habitats are favoured. All ecosystems are considered to possess the same intrinsic value when left alone to develop spontaneously, regardless of the start point. There is no hierarchy of outcomes and certainly no reference to historical accuracy.

Interpretation 5 does not acknowledge the damaging impacts of the many introduced species on New Zealand's unique and vulnerable species and ecosystems. Naturalised introduced species continue to threaten many indigenous species and ecosystems. Areas at particular risk from plant pests include wetlands, sand dune communities, rivers and lakes, coastal margins, riparian margins, and coastal and lowland remnant vegetation (Froude 2002). Without ongoing human management, introduced animal pest species threaten almost all New Zealand terrestrial and freshwater ecosystems and many plant and animal species. Present and future management of naturalised plant and animal pest species is essential for the protection of New Zealand's ecological natural character.

Some New Zealand ecosystems have nearly been lost because of past human actions, but ironically human intervention is now needed to retain what remains. For example, burning by humans has largely removed the fire-sensitive but drought-tolerant woody vegetation of the south-eastern South Island and resulted in its replacement by *Chionochloa* tussock grasslands (McGlone 2001). Given the present-day risk of fire it is likely that human intervention will be needed to protect and maintain a few examples of this possibly globally unique woody vegetation (McGlone 2001).

Interpretation 5 does not address criteria 3, 5 or 6 in Table 1 and only partly addresses criteria 1 and 2.

Interpretation 6: Naturalness that includes ecologically harmonious human influence or actions

Povilitis (2002) expressed concern that interpretations of naturalness that focused on an absence of human intervention could work against ecological restoration activities. He suggested that ecologically harmonious human influences (such as restoring natural hydrological regimes) could be included within the concept of 'natural'. This would mean that an area that has been subject to intensive ecological restoration would be considered as natural as an area with the same ecological condition that has not been subject to intensive management. Povilitis observed that this would require the formulation of ecologically based rules to prevent adverse human impacts from being construed as 'natural'.

Interpretation 6 addresses criteria 1, 4 and 5 in Table 1. While interpretation 6 does not adequately address criteria 2, 3 or 6, it does not contradict these criteria.

Interpretation 7: Naturalness only includes humans if they are in a closed system

Margules and Usher's (1981) definition of a natural ecosystem included humans only if those humans were totally dependent on and limited by, that ecosystem. In this closed system there would be no import or export of people, food or materials.

Today very few, if any, indigenous people live in closed systems. The history of human occupation in New Zealand indicates that such a state potentially occurred for only a very limited time. The first humans arrived in New Zealand in AD 1280. This was followed by rapid environmental change including megafauna extinctions, marine mammal decline and deforestation (Wilmshurst et al. 2008). For a short period of time resource shortages and environmental degradation caused by Māori may have led to a semi-stable ecological state before the arrivals of the first Europeans in the 16th century. Since the arrivals of those first Europeans, Māori have not lived in a closed system.

Interpretation 7 does not adequately address criteria 2, 3, 5 or 6 in Table 1 and is not a relevant concept for the development of a definition of natural character for the New Zealand context.

Interpretation 8: Naturalness as possession of features and properties found in an 'ideal' natural ecosystem

Under this interpretation the most natural areas would be those whose features and properties most closely match an 'ideal' natural ecosystem. According to Siipi (2004) an 'ideal' natural ecosystem could be either an imaginary, totally natural ecosystem or real present-day examples that are closest to the 'ideal'.

The use of the term 'ideal' means that there is a level of ambiguity as to how the interpretation would be applied in particular circumstances. 'Ideal' could mean how New Zealand would have been today had humans not arrived. This meaning of 'ideal' would include species of plants and animals that have become extinct since human arrival. A good approximation of 'ideal vegetation' could be 'potential vegetation', which is the vegetation that could be expected to be present in an area assuming physical-change events such as volcanic eruptions had occurred but humans and their agents (introduced species) had not arrived (Leathwick et al. 2003).

Interpretation 8 generally addresses criteria 1, 3, 4, 5 and 6 in Table 1. There is a level of uncertainty here as the term 'ideal' could be interpreted in different ways. Criterion 2 does not appear to be adequately addressed by this interpretation.

Interpretation 9: Naturalness as similarity of biotic structure and composition, and physical/ecological processes compared with historical benchmarks

This differs from interpretation 8 by the use of real, usually historical, benchmarks. Several authors address this concept although in different ways.

The Department of Conservation (2001a, b) defined natural character as ecological condition. In particular, the natural character of an area represents the degree to which the original prehuman condition of an ecosystem remains. Under this definition the most modified areas have the least natural character. Natural character in this context is measured by quantifying the following five pressures:

- Amount of removal of biota through, for example, hunting, harvest, land clearance, fishing
- The level of consumptive pressure on native biota represented by the variety and abundance of introduced pests
- The level of competition pressure on native plants as indicated by the percentage cover of introduced plants
- The intensity of disturbance as indicated by the amount of change to, for example, natural hydrology, nutrients, substrate, light and temperature regimes
- The change in the natural character of the surrounding landscape associated with ecosystem fragmentation, loss of connectivity, and pests

Other authors tend to focus more directly on the state of the areas being assessed. For example, Lamb and Purcell (1990) used the degree to which vegetation structure and floristic composition were 'typical' as their representation of ecological naturalness. Purcell and Lamb (1998) considered that naturalness should encompass both vegetation parameters (vegetation type and foliar density) and the amount and type of human-induced change to that vegetation (primarily weed

Table 2. Summary of criteria in Table 1 met by each interpretation of naturalness

	Criterion					
Interpretation	1	2	3	4	5	6
1. Naturalness as that which is part of nature	Y	Pt	Y	Y	Pt	Pt
2. Naturalness includes humans and their activities	?	?	X	?	X	X
3. Naturalness as a contrast to 'artifactuality'	Y	Y	X	Y	X	X
4. Naturalness as historical independence from human actions	Y	Pt	Pt	Y	X	?
5. Naturalness is where ecosystem processes occur without human intervention	Pt	Pt	X	?	X	X
6. Naturalness that includes ecologically harmonious human influence or actions	Y	X	X	Y	Y	X
7. Naturalness only includes humans if they are in a closed system	?	X	X	?	X	X
8. Naturalness as possession of features and properties found in an 'ideal' natural ecosystem	Y	X	Y	Y	Y	Y
9. Naturalness as similarity of biotic structure and composition, and physical/ecological processes compared with historical benchmarks	Y	X	Y	Y	Y	Y

Y = criterion met; X = criterion not met; Pt = criterion only partly met; ? = uncertain how criterion is addressed.

invasion and grazing by domestic animals). In practice they assessed vegetation type, vegetation structural integrity, and foliar density.

Ridder's (2007a) less preferred definition of naturalness was that it is a property of species and ecosystems found in an area prior to specified historical benchmarks. He used industrialisation as this benchmark, while at the same time arguing that the industrialisation benchmark was arbitrary because humans affected ecosystems before this time.

Interpretation 9 does not distinguish between the naturalness of preserved versus restored ecosystems that have the same structure, composition, and processes compared with the chosen benchmark. As such it can be an appropriate objective for ecological restoration programmes where historical fidelity (as described by Higgs 2003) is sought.

Interpretation 9 addresses criteria 1, 3, 4, 5, and 6 in Table 1. Criterion 2 does not appear to be adequately addressed by this interpretation.

Key elements for a definition of natural character

As shown by Table 2 none of the nine interpretations fully addressed all of the six criteria in Table 1. The interpretations that met most of the Table 1 criteria do, however, provide a basis for a definition of natural character. Interpretations 8 and 9 both addressed all except criterion 2. Criterion 2 was best addressed by interpretation 3, which also addressed criteria 1 and 4.

As indicated by interpretations 8 and 9, the selection of appropriate baselines or reference conditions is an important part of a proposed definition of natural character. This is discussed further in the next section.

Another important concept is that of a continuum. Natural character is generally viewed as occurring on a continuum (Richmond & Froude 1998; Angermeier 2000; Maplesden & Boffa Miskell 2000; Boffa Miskell 2002; Czech 2004; Machado 2004). As long as some components of the biological system remain, there is still some naturalness present (Siipi 2004). Siipi (2004) suggested that, in the context of biological conservation, naturalness be considered as existing along a gradient made up of several independent factors. The most natural entities (e.g. remote unexplored areas) would be natural in all of the interpretations of naturalness. In contrast, while the most unnatural environments would be unnatural in a variety of ways, some naturalness exists as long as some biotic elements remain.

Reference conditions and baselines for evaluating naturalness

A variety of information sources can be used to compile reference conditions (Higgs 2003) that have historical fidelity for a particular area. The identification of local reference conditions can greatly assist the development of ecological restoration goals that provide for natural temporal and spatial variability. In contrast, a baseline is like a fixed-point 'snapshot'.

A number of authors have promoted a prehuman baseline against which naturalness should be assessed (e.g. Anderson 1991; Hunter 1996; Angermeier 2000; Stephens et al. 2002). It can be difficult to develop a prehuman baseline for areas where humans have been present for many thousands of years (Usher 1986)). It may be possible to identify a partial prehuman baseline for naturalness in recently settled lands such as New Zealand. However, while the broad prehuman New Zealand vegetation patterns are known, the importance of natural disturbance could make the application of these patterns at the local level more complex. Faunal extinctions and changes in distribution and abundance would make it difficult to identify locality-specific prehuman faunal baselines.

To overcome such problems, Czech (2004) proposed a pre-industrialisation benchmark for naturalness. This was based on the assumption that the industrialisation of the 18th and 19th centuries substantially increased economic production and consumption to a level several orders of magnitude higher than pre-industrial levels. For example, Oliver et al. (2002) used a pre-industrialisation benchmark of 1750 for evaluating vegetation condition in Australia, an approach criticised by Ridder (2007a), given the known significant impact of humans on the pre-industrialised Australian environment. Similarly, pre-industrial Māori in New Zealand had a major impact on New Zealand biota and ecosystems.

This pre-industrialisation, pre-Western colonisation perspective seems to be most common where authors are addressing larger continental land masses. In these cases the long period of human occupation has made it difficult to identify the impacts of early human activity (e.g. Comer 1997). Several authors have questioned the extent to which the impacts of pre-industrial indigenous people could be considered natural (Landres et al. 1998; Ridder 2007a; Pinnegar & Engelhard 2008).

Spatial scale is important when considering baselines and reference conditions. Natural character or naturalness can be evaluated at many scales. At the level of a biological population there may be a high level of naturalness (unless its structure has been significantly modified by human activities). At the biological community level

naturalness may be reduced by introduced species browsing, preying on and replacing indigenous species. Naturalness may be further reduced at the catchment or watershed scale due to widespread removal of natural habitats and their replacement by agricultural systems that use introduced species, and human settlements.

To address the problems of variable pre-industrialisation human impacts in different locations, Landres et al. (1998) suggested that a variable context-dependent baseline could be used. In areas where there has been a long history of human modification and historical baselines are not available, present-day least-disturbed communities may provide appropriate reference conditions.

A 'good', present-day example is often used to identify goals for ecological restoration, especially where the full prehuman or pre-industrialisation assemblage of species is no longer available because of extinctions and/or current conditions are hostile for the survival of some species at the site in question. Both situations are common in New Zealand because many bird species have become extinct (Taylor & Smith 1997) and many remaining species of fauna cannot survive on mainland New Zealand because of predation by alien species.

Appropriate reference conditions and baselines for New Zealand

At broad scales, appropriate terrestrial vegetation reference conditions could be based on the potential vegetation for different land environments as described in Leathwick et al. (2003). In some locations the underlying available physical (especially soils) and climatic data have limited the depiction of more detailed land environments and, by implication, the description of potential vegetation. Where more detail is required the development of reference conditions could draw more strongly on good quality present-day examples and historical information sources (including anecdotal reports, pollen profiles and archaeological remains) where these are available.

The development of appropriate terrestrial faunal reference conditions poses a particular challenge, as the concept of potential vegetation cannot be directly translated to terrestrial fauna. A major reason for this is the large number of extinctions of ecologically significant fauna (including all species of moa) since human arrival. In contrast, New Zealand's major habitat-forming plant species have not become extinct. Faunal reference conditions that exclude extinct species are likely to be most useful for ecological restoration purposes.

In the marine environment both plant and animal species can be habitat-forming, and many mobile species are harvested by humans. As with terrestrial environments, a variety of types of information (such as those described by Pinnegar & Engelhard 2008) could be used to construct prehuman or historical marine reference conditions. Prehuman reference conditions are most appropriate, given the major impacts of even low-technology harvesting on marine populations (Flannery 1994; Hamel et al. 2003; Pinnegar & Engelhard 2008).

Although a 20-class New Zealand Marine Environment Classification (MEC) has been developed for the New Zealand EEZ and the Hauraki Gulf (Snelder et al. 2005), currently it seems that the MEC could have only a limited role in the determination of appropriate reference conditions. This is because only 20 classes are used to cover the entire EEZ, some important variables have not been used to develop the classification thus far, and potential biotic descriptions (equivalent to those accompanying the Land Environments of New Zealand; e.g. Leathwick et al. 2003) are not yet available.

Human perceptions and experiences of natural character

Human perceptions of naturalness or natural character vary considerably. In contrast to the preceding nine interpretations of naturalness, the next three directly address human perceptions.

Naturalness as closeness to a perceived natural state

The perceived level of naturalness in an area depends on a variety of factors, including matters relating to the perceiver(s) rather than just the site itself. Therefore, perceived naturalness is context dependent. What is 'natural' in an urban setting would not necessarily be considered 'natural' in a remote setting (Tveit et al. 2006). Factors affecting landscape perception include familiarity and past experiences of the same or similar areas, mood, expectations and intentions, activity (e.g. work, leisure), social setting and socio-cultural aspects (Gobster et al. 2007).

In their assessment of public perceptions of naturalness in Coromandel, New Zealand, Fairweather and Swaffield (1999) found that while there was reasonable consistency in landscapes that participants identified as 'natural' (native vegetation), there were differences between the landscapes they considered to be unnatural. Using the Q method (McKeown & Thomas 1988), they identified two groups of people. The first group (Factor 1) considered that 'natural' meant an absence of human construction and artefacts. For this group the most unnatural landscapes were those with buildings, while the naturalness of treeless pasture was assessed as neutral. The second group (Factor 2) was prepared to accept some 'appropriate development' in more natural settings if it was sympathetic to the environment. Large-scale commercial plantation forestry was considered least natural, because of its potential impacts. Treeless pasture was also considered relatively unnatural.

Several authors have found that human perceptions of naturalness are not necessarily in agreement with ecological measures (Lamb & Purcell 1990; Wagner & Gobster 2007). In comparing human judgements of naturalness with measured ecological parameters of naturalness, the former found:

- Vegetation dominated by trees of more than 30 m in height was judged most natural, regardless of 'foliage cover'
- Vegetation dominated by shrubs 2–5 m high was judged to be of lowest naturalness and this judgement was unaffected by vegetation density
- Participants were generally unable to distinguish between levels of disturbance in this vegetation
- As foliage cover increased, participants were increasingly able to distinguish between levels of structural alteration
- As vegetation height increased it became harder for participants to distinguish between natural and altered vegetation. Extensively altered structure in the tallest forest was judged as relatively natural

Gobster et al. (2007) observed that the aesthetic experiences usually associated with wild North American landscapes, encountered in outdoor recreation, emphasise natural scenic beauty (the 'scenic aesthetic'). Landscape perception studies in this context have generally shown a strong positive correlation between perceived scenic beauty and perceived naturalness. For many wildlands, perceived naturalness closely matched more objective indicators of ecological quality. Several exceptions were noted, including ecologically valuable landscapes that are not scenically attractive. In contrast, they found that perceptions of North American agricultural landscapes were typified by an aesthetic of care where active stewardship by people is considered to be in harmony with nature, even though ecological outcomes are not necessarily consistent with that perception. Here there is a greater mismatch between perception and reality for environmental outcomes.

Using the Cape York Peninsula in Far North Queensland as a case study, Strang (1997) described human–environment relationships and why they differed between cultures and sexes. One picture in a photograph elicitation exercise involving the pastoralists was of a pernicious weed, the rubber vine. Very few of the pastoralist women (who largely worked and spent time around the homestead) recognised the vine, and described it as an attractive flower. In contrast, the men who worked out on the station recognised what it was, considered it a noxious weed, and wanted it removed.

Most authors have focused on the visual perceptions of naturalness as sight is a dominant human sense. There are of course

other senses – auditory, kinaesthetic and olfactory – that are also relevant in the on-site perception of naturalness.

Naturalness as a component of landscape visual quality

Landscape visual quality can be assessed by specialists (expert approach) or by selected populations of the community (psychophysical approach). Lothian (1999) evaluated the relative merits of each approach, concluding that, because beauty or visual quality is in the eye of the beholder, the psychophysical approach is most robust. In this paper perspectives from both approaches are considered.

Tveit et al. (2006) identified naturalness as one of nine key components in their expert framework for analysing landscape quality. Naturalness has been addressed in a number of landscape assessments (e.g. Wallace 1974; Byrne 1979; Carls 1979; Nieman 1980; Balling & Falk 1982; Mosley 1989; Fairweather & Swaffield 1999) and has often been reported to enhance landscape preference (Ulrich 1986; Kaplan & Kaplan 1989; Purcell & Lamb 1998; Hagerhall et al. 2004). Purcell and Lamb (1984) identified naturalness and the presence of water as two of the four attributes relevant to landscape preference.

There can be a degree of mismatch between the human visual quality preferences for naturalness (Hagerhall et al. 2004) and those for stewardship (Nassauer 1995). Nassauer (1995) observed that people see ecological quality or nature through cultural lenses, and in North America the concept of 'picturesque nature' leads many to prefer landscapes that look cared for, rather than truly 'natural'. Hagerhall et al. (2004) found that the fractal geometry (fractured shapes with repeating patterns when viewed at increasingly fine scales) found in much of nature could provide an explanation for the well-documented connection between visual landscape preference and naturalness.

The relationship between naturalness and preference is not necessarily linear (Tveit et al. 2006) and the degree of actual naturalness may be less important than perceived naturalness when determining landscape preference (Purcell & Lamb 1998). Familiarity can affect preference, although it is not necessarily the familiar environment that is preferred (Kaplan & Kaplan 1989). Where there is a greater knowledge and concern for indigenous species this has been shown to increase the preference for intact indigenous landscape (Kaplan & Herbert 1987).

Cross-cultural comparisons of preferences for natural environments indicate a relatively high level of agreement on likes and dislikes when cultures are similar (Kaplan & Kaplan 1989). There appear to be preference differences between ethnic groups (Anderson 1978; Kaplan & Talbot 1988) with signs of human influence, neatness and openness being far more important to some ethnic groups than others (Kaplan & Kaplan 1989). Age can also affect natural landscape preferences (Balling & Falk 1982; Miller 1984).

Naturalness as part of some human recreational experiences

Naturalness may influence a recreational experience through its contribution to the recreation setting. The recreational opportunity spectrum (Clark & Stankey 1979) is based on the assumption that the more variation in the environment, the more the variation in the types of recreational experiences a typical user could enjoy (Kliskey 1998). While the spectrum implies a continuum of experience within a continuum of settings, the relationship is not linear (Virden & Knopf 1989).

There are differences in how people relate to nature. In a study where participants were asked to rank photographs of settings based on their naturalness in the important tourist locations of Kaikoura and Rotorua, New Zealand, Newton et al. (2002) found two basic patterns of response. One they called the 'pure nature' view. This view of nature emphasises its wild or natural character without humans. The other view is what they called the 'cultured nature' viewpoint, which sees nature primarily as a resource for human enjoyment and activity. This perspective is defined more in terms of personal experience of the natural environment than by the attributes of the environment itself (Fairweather & Swaffield 2003).

The relationship between setting and the perception of wilderness was examined for the wilderness end of the recreational opportunity spectrum by Kliskey (1998), based on four properties of wilderness perception identified by Kliskey and Kearsley (1993). These properties were the absence of human impacts (artifactualism), aspects of vegetation and forest (naturalness), isolation, and remoteness. The study distinguished four levels of user-perceived wilderness that provided the experience of wilderness to the respective users. Naturalness based on vegetation was part of the wilderness experience, but was not distinguished from the impact of other factors.

Holmes (1995) observed that as wild nature is somewhere people go to contemplate and undertake leisure activities, rather than to do work-related activity, there is a tendency to consider human relationships to nature as being recreational. Several authors (e.g. Landres et al. 1998; Sloan 2002; Ridder 2007a, b) have discussed the distinction between 'natural' and 'wild', concluding that many areas that have high wilderness values also have high naturalness values. This can result in people incorrectly considering the two terms as synonymous. Duelli et al. (2007) has gone so far as to suggest that wilderness is always linked to naturalness (allowing natural processes) and unmanaged nature (no visible human interference).

The definition of natural character proposed in this paper does not include human perceptions and experiences as a part of the core definition. It does, however, include the primary environmental components that determine human perceptions and experiences of naturalness.

Conclusion

The following definition of natural character is the outcome of evaluations of a suite of naturalness interpretations derived from literature and assessed using a specially constructed set of criteria, appropriate reference conditions and baselines, and the complexities of human perception.

Natural character occurs along a continuum. The natural character of a 'site' at any scale is the degree to which it:

- *is part of nature, particularly indigenous nature*
- *is free from the effects of human constructions and non-indigenous 'biological artefacts'*
- *exhibits fidelity to the geomorphology, hydrology, and biological structure, composition, and pattern of the reference conditions chosen*
- *exhibits ecological and physical processes comparable with reference conditions*

Human perceptions and experiences of a 'site's' natural character are a product of the 'site's' biophysical attributes, each individual's sensory acuity, and a wide variety of personal and cultural filters.

This definition has been compared with New Zealand Court interpretations and commentaries on natural character, particularly Court decisions on cases appealed under the Resource Management Act 1991 (Froude 2010, PhD in prep.). It is being used to develop a methodology to measure natural character and its change in the context of the long-standing New Zealand statutory policy goal to preserve the natural character of the coastal environment and various freshwater environments and their margins. The development and use of methodology will facilitate evaluations of the effectiveness of a variety of measures intended to preserve the natural character of the coastal environment.

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References

Anderson E 1978. Visual resource assessment: local perceptions of familiar natural environments. Unpublished PhD thesis, University of Michigan, Ann Arbor, MI, USA. 213 p.

Anderson JE 1991. A conceptual framework for evaluating and quantifying naturalness. Conservation Biology 5: 347–352.

Angermeier PL 2000. The natural imperative for biological conservation. Conservation Biology 14: 373–381.

Balling JD, Falk JH 1982. Development of visual preference for natural environments. Environment and Behavior 14: 5–28.

Boffa Miskell 2002. Ministry for the Environment environmental performance indicators landscape aspect of natural character. Stage 2 outcomes of pilots undertaken in Wellington and Auckland. Part 1 revision of guidelines for the Ministry for the Environment natural character EPI monitoring programme. Unpublished paper prepared for the Ministry for the Environment, Wellington. 49 p.

Byrne SM 1979. Perception of the landscape in the Lands End Peninsula. Landscape Research 5: 21–24.

Carls EG 1979. Coastal recreation: aesthetics and ethics. Coastal Zone Management Journal 5: 119–130.

Castree N 2005. Nature. Key Ideas in Geography series. London, Routledge. 281 p.

Clark RN, Stankey GH 1979. The recreation opportunity spectrum: a framework for planning, management and research. USDA Forest Service General Technical Report PNW 98. Portland, OR, USA, USDA Pacific Northwest Forestry Experimental Station.

Comer PJ 1997. Letters: A 'natural' benchmark for ecosystem function. Conservation Biology 11: 301–303.

Czech B 2004. A chronological frame of reference for ecological integrity and natural conditions. University of New Mexico School of Law Natural Resources Journal 44: 1113–1136.

Department of Conservation 2001a. Tracking the fate of New Zealand's natural heritage. Fact sheet. Wellington, Science & Research Unit, Department of Conservation. 4 p.

Department of Conservation 2001b. Making the best choices for conservation. Wellington, Science & Research Unit, Department of Conservation. 24 p.

Duelli P, Baur P, Buchecker M, Gugerli F, Holderegger R, Wohlgemuth T 2007. The role of value systems in biodiversity research. In: Kienast F, Wildi O, Ghosh S eds A changing world. Challenges for landscape research. Landscape series 8. Dordrecht, Netherlands, Springer. Pp. 27–34.

Dunlap TR 1999. Nature and the English Diaspora: environment and history in the United States, Canada, Australia, and New Zealand. Cambridge University Press. 350 p.

Fairweather JR, Swaffield SR 1999. Public perceptions of natural and modified landscapes of the Coromandel Peninsula, New Zealand. Research Report No. 241. Lincoln University, Canterbury, New Zealand, Agribusiness and Economics Research Unit. 54 p.

Fairweather J[R], Swaffield S[R] 2003. Public perceptions of natural character and implications for the forest sector. New Zealand Journal of Forestry 47(4): 24–30.

Flannery TF 1994. The future eaters. An ecological history of the Australasian lands and people. Chatswood, NSW, Reed. 423 p.

Froude JA 1886. Oceana: Travellers' tales of early Australia and New Zealand. London, Longman, Greens.

Froude VA 2002. Biological control options for invasive weeds of New Zealand protected areas. Science for Conservation 199. Wellington, Department of Conservation. 68 p.

Gobster PH, Nassauer JI, Daniel TC, Fry G 2007. The shared landscape: what does aesthetics have to do with ecology? Landscape Ecology 22: 959–972.

Hagerhall CM, Purcell T, Taylor R 2004. Fractal dimension of landscape silhouette outlines as a predictor of landscape preference. Journal of Environmental Psychology 24: 247–255.

Haila Y 1997. Letters: A "natural" benchmark for ecosystem function. Conservation Biology 11: 300–301.

Hamel J, Allen RB, Davis L, McGovern-Wilson R, Smith I, Petchey P 2003. The human factor. In: Darby J, Fordyce RE, Mark A, Probert K, Townsend C eds The natural history of southern New Zealand. Dunedin, University of Otago Press. Pp.129–151.

Higgs E 2003. Nature by design: people, natural process, and ecological restoration. Cambridge, MA, The MIT Press. 341 p.

Hitchmough R, Bull L, Cromarty P compilers 2007. New Zealand Threat Classification System lists – 2005. Wellington, Department of Conservation.

Holmes R III 1995. Conserving natural value. Perspectives in Biological Diversity series. New York, Columbia University Press. 259 p.

Hunter M Jr 1996. Benchmarks for managing ecosystems: are human activities natural? Conservation Biology 10: 695–697.

Kaplan R, Herbert EJ 1987. Cultural and sub-cultural comparisons in preferences for natural settings. Landscape and Urban Planning 14: 281–293.

Kaplan R, Kaplan S 1989. The experience of nature: A psychological experience. Cambridge, NY, Cambridge University Press. 340 p.

Kaplan R, Talbot JF 1988. Ethnicity and preference for natural settings: A review and recent findings. Landscape and Urban Planning 15: 107–117.

King M 2003. The Penguin history of New Zealand. Auckland, Penguin Books. 563 p.

Klein U 2000. Belief-views on nature – Western environmental ethics and Maori world views. New Zealand Journal of Environmental Law 4: 81–119.

Kliskey AD 1998. Linking the wilderness perception mapping concept to the recreation opportunity spectrum. Environmental Management 22: 79–88.

Kliskey AD, Kearsley GW 1993. Mapping multiple perceptions of wilderness in southern New Zealand. Applied Geography 13: 203–223.

Lamb RJ, Purcell AT 1990. Perception of naturalness in landscape and its relationship to vegetation structure. Landscape and Urban Planning 19: 333–352.

Landres PB, White PS, Aplet G, Zimmermann A 1998. Naturalness and natural variability: definitions, concepts, and strategies for wilderness management. In: Kulhavy DL, Legg MH eds Wilderness and natural areas in eastern North America: research, management and planning. 1st edn. Nacogdoches, Texas, Centre for Applied Studies in Forestry, Stephen F. Austin State University. Pp. 41–50.

Landres PB, Morgan P, Swanson FJ 1999. Overview of the use of natural variability concepts in managing ecological systems. Ecological Applications 9: 1179–1188.

Leathwick JR, Wilson G, Rutledge D, Wardle P, Morgan F, Johnston K, McLeod M, Kirkpatrick R 2003. Land environments of New Zealand Ngā Taiao o Aotearoa. Auckland, David Bateman. 184 p.

Lothian A 1999. Landscape and the philosophy of aesthetics: is landscape quality inherent in the landscape or in the eye of the beholder? Landscape and Urban Planning 44: 177–198.

Lovelock J 1988. The ages of Gaia – a biography of our living earth, 1st edn. Oxford University Press. 252 p.

Lovelock J 2000. Gaia – a new look at life on earth, 4th edn. Oxford University Press. 148 p.

Machado, A 2004. An index of naturalness. Journal for Nature Conservation 12: 95–110.

Maplesden R, Boffa Miskell 2000. Natural character – concept development in New Zealand law planning and policy. Technical Report 2000/4, Hamilton, Environment Waikato. 101 p.

Margules CR 1986. Conservation evaluation in practice. In: Usher

MB ed. Wildlife conservation evaluation. London, Chapman & Hall. Pp. 297–314.
Margules C, Usher MB 1981. Criteria used in assessing wildlife conservation potential: a review. Biological Conservation 21: 79–109.
McGlone MS 2001. The origin of the indigenous grasslands of southeastern South Island in relation to pre-human woody ecosystems. New Zealand Journal of Ecology 25(1): 1–15.
McGlone M[S], Wardle P, Worthy T 2003. Environmental change since the Last Glaciation. In: Darby J, Fordyce RE, Mark A, Probert K, Townsend C ed. The natural history of southern New Zealand. Dunedin, University of Otago Press. Pp. 105–128.
McKeown B, Thomas D 1988. Q methodology. Sage University Paper series on Quantitative Applications in the Social Sciences no. 07-066. Newbury Park, CA, USA, SAGE. 83 p.
McRae SR, Lucas DJ, Courtney SP, Baxter AS, Barrier RF, Lynn IH 2004. A natural character framework for the Marlborough Sounds. Occasional Publication Number 62. Department of Conservation, Nelson/Marlborough Conservancy. 70 p.
Miller PA 1984. Visual preference and implications for coastal management: a perceptual study of the British Columbia shoreline. Unpublished PhD thesis, University of Michigan, Ann Arbor, MI, USA. 196 p.
Minister of Conservation 1994. New Zealand Coastal Policy Statement 1994. Gazetted 5 May 1994. Wellington, Department of Conservation. 26 p.
Minister of Works and Development 1974. Coastal planning and development. Ministerial statement. Wellington, Ministry of Works and Development. 10 p.
Ministry for the Environment 2007. Lake water quality in New Zealand: status in 2006 and recent trends 1990–2006. Wellington, Ministry for the Environment. 62 p.
Ministry for the Environment 2007. Environment New Zealand 2007. Wellington, Ministry for the Environment. 456 p.
Mosley MP 1989. Perceptions of New Zealand river scenery. New Zealand Geographer 45(1): 2–13.
Nassauer JI 1995. Messy ecosystems, orderly frames. Landscape Journal 14: 161–170.
Newton BM, Fairweather JR, Swaffield SR 2002. Public perceptions of natural character in New Zealand: wild nature versus cultured nature. New Zealand Geographer 58(2): 17–29.
Nieman TJ 1980. The visual environment of the New York coastal zone: user preferences and perceptions. Coastal Zone Management Journal 8(1): 45–61.
Oliver I, Smith PL, Lunt I, Parkes D 2002. Pre-1750 vegetation, naturalness and vegetation condition: What are the implications for biodiversity conservation? Ecological Management & Restoration 3: 176–178.
Olwig K 1984. Nature's ideological landscape – A literary and geographic perspective on its development and preservation on Denmark's Jutland Heath. The London Research Series in Geography. London, George Allen & Unwin. 115 p.
Pinnegar JK, Engelhard GH 2008. The 'shifting baseline' phenomenon: a global perspective. Reviews in Fish Biology and Fisheries 18: 1–16.
Povilitis T 2002. What is a natural area? Natural Areas Journal 22(1): 70–74.
Purcell AT, Lamb RJ 1984. Landscape perception: an examination and empirical investigation of two central issues in the area. Journal of Environmental Management 19: 31–63.
Purcell AT, Lamb RJ 1998. Preference and naturalness: An ecological approach. Landscape and Urban Planning 42: 57–66.
Richmond C, Froude V 1998. Preserving the natural character of estuaries and other sensitive coastal environments. In: Wallace CC, Weeber B, Buchanan S eds Seaviews: marine ecosystems management obligations and opportunities. Proceedings of the conference held in Wellington, 11–14 February 1998. Wellington, New Zealand Environment and Conservation Organisations of New Zealand. Pp. 111–119.
Ridder B 2007a. An exploration of the value of naturalness and wild nature. Journal of Agricultural and Environmental Ethics 20: 195–213.
Ridder B 2007b. The naturalness versus wilderness debate: ambiguity, inconsistency, and unattainable objectivity. Restoration Ecology 15: 8–12.
Roberts M, Norman W, Minhinnick N, Wihongi D, Kirkwood C 1995. Kaitiakitanga: Maori perspectives on conservation. Pacific Conservation Biology 2: 7–20.
Schnitzler A, Génot J-C, Wintz M, Hale BW 2008. Naturalness and conservation in France. Journal of Agricultural and Environmental Ethics 21: 423–436.
Siipi H 2004. Naturalness in biological conservation. Journal of Agricultural and Environmental Ethics 17: 457–477.
Sloan NA 2002. History and application of the wilderness concept in marine conservation. Conservation Biology 16: 294–305.
Snelder T, Leathwick J, Dey K, Weatherhead M, Fenwick G, Francis M, Gorman R, Grieve J, Hadfield M, Hewitt J, Hume T, Richardson K, Rowden A, Uddstrom M, Wild M, Zeldis J 2005. The New Zealand marine environment classification. Wellington, Ministry for the Environment. 70 p.
Stephens RTT, Brown DJ, Thornley NJ 2002. Measuring conservation achievement: concepts and their application over the Twizel Area. Science for Conservation 200. Wellington, Department of Conservation. 114 p.
Strang V 1997. Uncommon ground – cultural landscapes and environmental values. Explorations in Anthropology. Oxford, Berg. 309 p.
Taylor R, Smith I 1997. The state of New Zealand's environment. Wellington, Ministry for the Environment.
Tong RJ, Cox G 2000. Clean and green? The New Zealand environment. Auckland, David Bateman. 112 p.
Tveit M, Ode A, Fry G 2006. Key concepts in a framework for analysing visual landscape character. Landscape Research 31: 229–255.
Ulrich RS 1986. Human responses to vegetation and landscapes. Landscape and Urban Planning 13: 29–44.
Usher MB 1986. Wildlife conservation evaluation: attributes, criteria and values. In: Usher MB ed. Wildlife conservation evaluation. London, Chapman and Hall. Pp. 4–44.
Virden RJ, Knopf RC 1989. Activities, experiences, and environmental settings: A case study of recreation opportunity spectrum relationships. Leisure Sciences 11(159–176).
Wagner MM, Gobster PH 2007. Interpreting landscape change: Measured biophysical change and surrounding social context. Landscape and Urban Planning 81: 67–80.
Wallace BC 1974. Landscape evaluation and the Essex Coast. Regional Studies 8: 299–305.
Wilmshurst JM, Anderson AJ, Higham TFG, Worthy TH 2008. Dating the late prehistoric dispersal of Polynesians to New Zealand using the commensal Pacific rat. Proceedings of the National Academy of Sciences of the United States of America 105: 7676–7680.
Wilson K-J 2003. Flight of the huia: ecology and conservation of New Zealand's frogs, reptiles, birds and mammals. Christchurch, Canterbury University Press. 411 p.

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